

**AMENDMENTS TO THE CLAIMS:**

This listing of claims will replace all prior versions, and listings, of claims in the application:

**LISTING OF CLAIMS:**

1. (Currently Amended) A substrate for an ion-exchange ~~system~~ electrode structure, said substrate comprising a an exterior surface wherein at least a portion of the exterior surface is irradiated by a laser radiation to enlarge a reactive surface area on the exterior surface.
2. (Currently Amended) The substrate of claim 1, wherein the portion of the surface is irradiated by exposing the surface to the laser radiation near an ablation threshold of the ~~membrane~~ substrate.
3. (Original) The substrate of claim 1, wherein the portion of the surface is irradiated by melting, boiling, or quenching part of the surface with laser radiation.
4. (Original) The substrate of claim 1, wherein the laser irradiated surface is coated with a layer of conductive material.
5. (Original) The substrate of claim 4, wherein the conductive material is a metal or an alloy.

6. (Original) The substrate of claim 4, wherein the layer of conductive material is further coated with a continuous or discontinuous layer of catalytic material.
7. (Original) The substrate of claim 6, wherein the catalytic material is selected from a group consisting of Pt, Pt alloys, V, V alloys, titanium dioxide, iron, nickel, lithium and gold.
8. (Original) The substrate of claim 1, wherein the laser irradiated surface is coated with a continuous or discontinuous layer of catalytic material.
9. (Original) The substrate of claim 8, wherein the catalytic material is selected from a group consisting of Pt, Pt alloys, V, V alloys, titanium dioxide, iron, nickel, lithium and gold.
10. (Original) The substrate of claim 8, further comprising micro openings wherein a fuel flows through the micro openings to reach the catalytic material.
11. (Withdrawn) An ion exchange membrane with an enlarged reactive surface, said membrane is produced by:
  - providing a laser roughened surface;
  - covering the laser roughened surface with a solution;
  - allowing the solution to solidify to form an ion exchange membrane; and
  - separating the ion exchange membrane from the laser roughened surface,

wherein said ion exchange membrane has an enlarged reactive surface that is a negative replica of the laser roughened surface.

12. (Withdrawn) The ion exchange membrane of claim 11, wherein the solution comprises an electrolyte and a solvent.

13. (Withdrawn) The ion exchange membrane of claim 12, wherein the electrolyte is selected from a group consisting of sulfonated ion-conducting aromatic polymer, phosphonated ion-conducting aromatic polymer, carboxylated ion-conducting aromatic polymer and perfluorinated co-polymer, and wherein the solvent is selected from a group consisting of lower aliphatic alcohols, water, and a mixture thereof.

14. (Withdrawn) The ion exchange membrane of claim 11, wherein the enlarged reactive surface is further coated with a layer of conductive material.

15. (Withdrawn) The ion exchange membrane of claim 14, wherein the conductive material is a metal or an alloy.

16. (Withdrawn) The ion exchange membrane of claim 14, wherein the enlarged reactive surface is further coated with a continuous or discontinuous layer of catalytic material.

17. (Withdrawn) The ion exchange membrane of claim 16, wherein the catalytic material is selected from a group consisting of Pt, Pt alloys, V, V alloys, titanium dioxide, iron, nickel, lithium and gold.

18. (Withdrawn) An ion exchange membrane with an enlarged reactive surface, said ion exchange membrane is produced by : providing an ion exchange membrane; providing a laser roughened surface; stamping the ion exchange membrane with the laser roughened surface; and separating the ion exchange membrane from the laser roughened surface, wherein the stamped ion exchange membrane has an enlarged reactive surface that is a negative replica of the laser roughened surface.

19. (Withdrawn) An ion exchange membrane with enlarged reactive surfaces on a front side and a back side, said ion exchange membrane is produced by:

providing a mold having an inner upper surface and an inner lower surface;

filling the mold with a solution;

allowing the solution to solidify to form an ion exchange membrane; and

separating the ion exchange membrane from the mold, wherein the inner upper surface and inner lower surface of the mold are roughened by laser irradiation, and

wherein said ion exchange membrane has an upper surface that is a negative replica of the inner upper surface of the mold and a lower surface that is a negative replica of the inner lower surface of the mold.

Claims 20-46 (Canceled).

47. (New) The substrate of claim 1, wherein the reactive surface area includes a projecting surface feature.

48. (New) The substrate of claim 47, wherein the projecting surface feature is cone-shaped.

49. (New) The substrate of claim 1, wherein the reactive surface area has two-scales of roughness, a first scale of roughness at least three orders of magnitude different than a second scale of roughness.

50. (New) The substrate of claim 49, wherein the first scale of roughness is about  $10^{-6}$  meters.